

means for generating a first signal in response to the touching contact;

means for transmitting the first signal to a processor;

means for creating a haptic output current signal in response to said first signal;

means for carrying said haptic output current signal to an actuator arranged to create relative motion between a first structural element and a second structural element thereof, the first structural element mechanically coupled to the touch-sensitive panel and the second structural element mechanically coupled to a display device; and

means for causing a haptic effect by actuating the actuator.

**21.** A touch panel apparatus for providing haptic effects, the apparatus comprising:

means for detecting a touching contact with a touch-sensitive panel;

means for generating a first signal in response to the touching contact;

means for transmitting the first signal to a processor;

means for creating a haptic output current signal in response to said first signal;

means for carrying said haptic output current signal to an actuator arranged to create relative motion between a first structural element and a second structural element thereof, the first structural element mechanically coupled to the touch-sensitive panel and the second structural element mechanically coupled to a display device, wherein the actuator further includes

a first biasing element coupling the first structural element to the second structural element;

a first magnetic device carried by the first structural element, the first magnetic device including a first pole piece;

a second magnetic device carried by the second structural element, the second magnetic device including a second pole piece;

a first coil disposed about at least one of said first pole piece and said second pole piece.

wherein the first biasing element is arranged to provide a biasing force opposing an attractive magnetic force urging the first and second pole pieces together when current is applied to the first coil; and

means for causing a haptic effect by actuating the actuator.

**22.** A touch panel assembly, comprising:

a touch-sensitive panel; and

an actuator including

a first structural element;

a second structural element;

a first biasing element coupling the first structural element to the second structural element;

a first magnetic device carried by the first structural element, the first magnetic device including a first pole piece; and

a second magnetic device carried by the second structural element, the second magnetic device including a second pole piece;

a first coil disposed about at least one of said first pole piece and said second pole piece;

wherein the first biasing element is arranged to provide a biasing force opposing an attractive magnetic force urging the first and second pole pieces together when current is applied to the first coil;

wherein the actuator is arranged so that its first structural element is mechanically coupled to the touch-sensitive panel or its support structure.

**23.** The touch panel assembly of claim 22, wherein the touch-sensitive panel is substantially transparent and is disposed adjacent to the display device so that a user may observe the display device through the touch-sensitive panel.

**24.** The touch panel assembly of claim 22, wherein the actuator includes a second coil disposed about at least one of said first pole piece and said second pole piece.

**25.** The touch panel assembly of claim 22, further comprising a second biasing element, wherein the second biasing element is arranged to provide a biasing force opposing an attractive magnetic force urging the first and second pole pieces together when current is applied to the first coil.

**26.** The touch panel assembly of claim 22, wherein the first biasing element comprises a spring.

**27.** The touch panel assembly of claim 22, wherein the first biasing element comprises an elastomeric element.

**28.** The touch panel assembly of claim 22, wherein the first biasing element comprises a foam material.

**29.** The touch panel assembly of claim 22, wherein the first and second structural element and the first biasing element are all formed from the same material and the first biasing element is formed thinner than the first and second structural elements so that it is free to flex when perturbed.

**30.** The touch panel assembly of claim 22, wherein an electric current applied to the first coil causes the actuator to generate haptic effects by creating movement of said touch-sensitive panel.

**31.** The touch panel assembly of claim 10, wherein an electric current applied to at least one of said first and second coils causes the actuator to generate haptic effects by causing movement of the touch-sensitive panel.

\* \* \* \* \*